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THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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PHYSICS IN THE SERVICE OF ASTRONOMY

By Lachlan Gilchrist

(Annual Address of the President, January 22, 1935)

So fundamental is the character of physics and its presentation mathematically that its services are enlisted in practically all investigations in astronomy, as indeed in those in the so-called exact sciences generally; and no attempt will be made to treat the subject comprehensively. These services will be considered in a very limited, but important, field of astronomy, in an endeavour to outline some progress made in recent years.

Astronomical investigations are dependent largely on telescopes and spectroscopes. Of the former there are the refracting and reflecting types, while the latter utilize prisms, gratings and interferometers, singly or in combination.

The distances from our nearest neighbours in our solar system are great. Even if it were possible to make a visit for direct investigation with the speed of the fastest aeroplane (say ten miles a minute), it would take almost seven years to reach Mars when it is nearest to us, seventy to Jupiter, and 512 to Neptune. If, however, we wished to visit the nearest star at this speed it would take about five million years, and there are other stars certainly a thousand times as far away. If we could travel with the velocity of light (186,000 miles per second) the sun could be visited in eight minutes, Neptune in four hours—but the nearest star in four and one-third years! The recent investigation by Plaskett and Pearce at the Dominion Astrophysical Observatory give the diameter of our galaxy as 30,000 parsecs or 100,000 light-years, the solar system

being placed about 10,000 parsecs from the centre of the galaxy and hence 5,000 parsecs from the nearest boundary. From these figures one should travel with the speed of light to the nearest limits of our galaxy in about 16,000 years, to visit other galaxies such as the spiral nebulae are believed to be, it would require in many cases millions of years to make the journey with the speed of light, and still more millions of years to reach the confines of the universe, or perhaps indeed simply to come back home, for recent investigations or speculations make the "confines of the universe" elusive, if not actually indeterminate. To obtain information of the universe resort must be made to the interpretation of the light signals which reach us from the members of our solar system or from the stars in space. In these investigations optical instruments are, of course, indispensable.

At the present time special efforts are being made to construct telescopes and spectroscopes of such size and refinement that the fields of investigation may be greatly extended. For example, by the use of a reflecting telescope of 200 inches diameter it will be possible to extend at least three times farther outward the bounds of the visible universe, and the modern spectroscopes, which are used alone or in conjunction with telescopes, have increased greatly our knowledge of the aurora, of the magnetic properties of sun spots and of the sun itself, of the size and motions of the sun and stars, and even of the motions of the distant galaxies. There has been deduced a definite connection between receding radial motion of the galaxies and their distances.

Representative progress during the past year and proposals for the future may be placed in the two following divisions, which, however, are not very comprehensive nor complete within themselves. They may serve to indicate avenues of investigation that are being successfully explored: (I) Image definition and spatial resolution of astronomical sources of light. (II) Astrophysical spectroscopy.

I. Image Definition and Spatial Resolution of Astronomical Sources of Light.

The stars are so distant that they act as point sources of light and the largest telescope receives only a small portion of the wave front of the light from the star and focusses it to a very small bright

circular disc-image surrounded by concentric circular rings. The intensity of the disc and rings depends directly on the light-gathering power of the telescope, which is proportional to the square of the diameter of the mirror or lens of the telescope. If spherical and chromatic aberrations are eliminated which may almost be achieved in the paraboloidal mirror, the angular width of the image, as seen from the vertex, or centre of the mirror, $\theta = 2 \times 1.22 \times (\lambda/d)$, where λ is the mean wave-length of the light and d is the aperture of the mirror. From this it is seen that the shorter the mean wave-length and the greater the aperture, the smaller is the image in the telescope. For a reflecting telescope of 200 inches in diameter and a focal length of 50 feet, if the mean wave-length of the light from a star is 5000×10^{-8} cm. (yellow-green), the diameter of the disc-image will be approximately 1/7500 cm. If the star has a diameter comparable with its distance the width of the image will be correspondingly increased. If in the telescope the aberrations are not eliminated the image may be so wide and diffuse that the definition is greatly blurred. If the light comes from two closely adjacent stars there will be two adjacent disc-images, each surrounded by its own system of circular fringes. The separation of the images will depend on the distance apart of the stars themselves. If the disc-image of one star is separated from that of the other by one-half the width of the disc, the images are considered to be separated or resolved. It is evident that the angular separation of stars that may be seen resolved is $\theta = 1.22(\lambda/d)$. This, of course, will not hold if the light is too complex or if aberrations are not eliminated. For successful elimination of the aberration it is necessary that the mirror be made accurately paraboloidal in form and the changes with temperature be rendered as small as possible. Even small irregularities on the surface must not be higher than a small fraction of a wave-length of light. It is a tribute to the skill of the manufacturers of many of our best telescopes that in actual practice stars have been resolved with an angular separation considerably smaller than that given by the formula. In order that the image intensity may be strong there must be slight loss of light at the reflecting surface. This has hitherto been provided by frequent re-coating of the surface with silver, which has a high coefficient of reflection when fresh but which deteriorates rapidly. A great improvement,

in the latter respect at least, has been obtained by replacing the silver coating by aluminum which is formed from the vapour of the metal condensed on the surface in a vacuum. This coating is found to adhere strongly, to have a high coefficient of reflection, and to remain untarnished for an indefinite time.

With the increase in the intensity of light in the image owing to the improvement in the coating, and in the resolving power of the telescope owing to the increase of the aperture, the number of the stars within the reach of the telescope has been largely increased. The number which may be revealed by the 100-inch reflector at Mount Wilson is estimated at more than 30,000 million and with the 200-inch reflector now under construction many millions more will probably be reached.

It should be recalled that the chief uses of the large surface of the mirror are (1) to gather more light, and (2) to narrow and intensify the image. The light from *any* portion of the mirror will form an image which, though faint, will be a portion of the image due to the whole mirror; and in fact if one used two portions of the mirror at opposite ends of a diameter there would be obtained a set of fringes which is a modified cross-section of the whole image in a line parallel to the line joining the two portions of the mirror. It follows then that if a disc-image is not required and if the diminution in intensity is not too great, the large mirror may be replaced by two small mirror-sections at the opposite ends of a diameter and there is produced a fringe-system-image from which may be obtained almost as much information as is obtained from the image formed when the whole mirror is used. Further, when the whole mirror is used the definition of *any* point of the image is blurred by the passage of the *whole* wave front through turbulent air; while, with the two-small-mirrors arrangement, where only two small portions of the wave front are used, the definition is much improved, and in fact, on nights when "seeing" is so poor as to render the use of the whole mirror impossible, the modified method is still available. This fact shows the fundamental character of the Fresnel hypothesis that each point on a wave front must be regarded as an individual source of light. A slight but important modification of the arrangement was made by Michelson in which two small plane mirrors were placed at the ends of a twenty-foot-long support. Two

portions of the wave-front, twenty feet apart, were reflected from these mirrors inward to two auxiliary mirrors which in turn reflected the two beams to the paraboloidal mirror of the 100-inch telescope. By this device the fringe-system-image become widened to that of a small aperture telescope and visibility was improved. The angular diameters of several stars and the separation of close double stars were obtained from the change in visibility of the fringes as the distance between the outer mirrors was altered.

By means of the arrangement thus briefly sketched it has been found possible to determine the size and shape of a distant source of light. Michelson developed the necessary visibility formula in 1890 and during the next year at the Lick observatory applied it to measure the angular diameters of the satellites of Jupiter. Thirty years later the method was used to measure the angular diameter of α Orionis (Betelgeuse). By a modification of the method, J. A. Anderson investigated the nature of the close double star Capella which had previously been analyzed spectroscopically. The operation of the method, even under good atmospheric conditions, is difficult. In spite of this, however, it has been applied by P. W. Merrill to 85 stars, six of which gave evidence of being double, and by H. S. Jones, K. F. Bottlinger, M. Maggini and others. Maggini gives results for 38 double stars whose separations are less than 0″.7. Merrill also showed that Betelgeuse is not a double star, but that its diameter varies periodically. For the binary ϵ Hydrae the spectroscopic orbit agrees well with that obtained visually; while for Capella the spectroscopic and interferometer orbits are in good agreement.

II. Astronomical Spectroscopy

Image definition and resolution are of fundamental importance in other branches of astrophysics, such as, the analysis of a primary source of radiation into its simplest elements; investigations on the constitution, the magnetic properties and the motions of the material of the sun; investigations on the temperature, distance, constitution and motion of stars and nebulae and the matter in interstellar space; and in investigations on the atmospheres of the planets.

Analysis of a Source of Radiation

In an analysis of this sort various types of instruments are used

and usually with incomplete resolution. Indeed agreement on an acceptable definition of the limit of resolution of the components of a complex source has not yet been reached. Using his interferometer and interpreting the form of the visibility curve, Michelson accurately analyzed the red and green lines of cadmium, the red line of hydrogen, the green line of thallium, and other lines; and other physicists also have measured the widths of hydrogen lines.

It should be noted that the visibility method used by Michelson in the analysis of a source of light is the same as that used to determine the angular diameter of a star. It is indirect and therefore somewhat unsatisfactory, and spectroscopes which make visible the components of a complex source of light are used more extensively. Instruments of a kind known as multiple reflection interferometers have been designed by Lummer and Gehrcke and by Fabry and Perot. They are used effectively to analyze light from terrestrial sources, but in general for the heavenly bodies resort is made to prism spectroscopes or to diffraction gratings.

Investigations on the Sun

In 1842, Doppler enunciated his principle that the light from a body in motion relative to the observer should show the lines in its spectrum displaced. This effect has been used extensively in determining the motions of the sun, the planets and the stars. By this means not only is the rotation of the sun determinable but also the motions of portions of its atmosphere.

It will be recalled that the telescope presents the image of a star as a bright central disc surrounded by concentric rings, and shows two near-together stars resolved if the centre of the bright disc of one star is displaced sufficiently to fall upon the first dark ring of the second star. Somewhat similarly the spectroscope presents the image of a source of light as a system of fringes, for each component wave-length in the light, in the form of a central bright fringe with adjacent dark and faintly bright fringes, and the systems of fringes are dispersed or separated by the spectroscope. If the central bright fringe of the image-system of one of the components of wave-length λ_1 is dispersed until it falls on the first dark fringe of the image-system of the other component of wave-length λ_2, the two components are considered to be resolved, and the resolving power of the spectroscope is indicated numerically as $\lambda/(\lambda_1-\lambda_2)$, where λ is

the mean of λ_1 and λ_2. This definition of resolving power was given by the late Lord Rayleigh. To show the two sodium lines separated requires a resolving power of about 1000.

The diffraction grating gives a series of images which are again systems of fringes. Resolving powers of 100,000, or twenty times that of a prism spectroscope, are readily obtained.

In order to obtain high resolving power and at the same time confine the light to the image system of fringes of high order, Michelson designed the echelon grating, which is composed of a number of plates of glass of equal thickness placed in step, or echelon form. With this instrument a resolving power of 1,000,000 or more is attainable. Indeed in Michelson's original echelon there were 60 plates of glass each 3 cm. thick, and the resolving power was over 1,500,000. Houston in 1927 placed two Fabry and Perot interferometers in series and obtained a still higher resolving power. He was able to resolve directly the hydrogen lines Hα, Hβ, Hγ.

In 1896, Professor Zeeman announced the shifting and splitting of spectral lines when the source of light was in a magnetic field, and some twelve years later, Hale, by means of this "Zeeman effect", showed that there was a magnetic field around a sun spot and indeed that the entire sun has a magnetic field.

Photographs of sun-spot spectra were made at Mount Wilson, 1915-1917. These and extensive information on the Zeeman components have furnished a basis for interpretative study by Hale and Ellerman and by other astronomers. They found:

(1) The spots exist in pairs, one representing the N-seeking and the other the S-seeking pole.

(2) The pairs of poles are usually located at greater or less intervals, side by side, parallel to the sun's equator.

(3) Sun spots of a new 11.5-year cycle which appear in high latitudes after a minimum of solar activity are of opposite polarities in the northern and southern hemispheres, and as the cycle progresses the mean latitude of the spots in each hemisphere steadily decreases but their polarity remains unchanged. Further, that high latitude spots of the next 11.5-year cycle appear during the last year of the first cycle and gradually increase in intensity and diminish in latitude but are of reversed magnetic polarity, i.e., there is a full spot-period with reference to magnetic polarity of about 23 years.

In view of the apparent correlation with sun spots of such terrestrial phenomena as magnetic storms, auroral phenomena, disturb-

ances in radio and telegraphic communication, it is imperative that an intensive campaign of investigation of sun spot phenomena should be inaugurated.

Recently in an extensive study 416 lines, chiefly in the sun spot spectra, were analyzed by Robert B. King (*Astrophysical Journal* 1934) in an endeavour to obtain the distribution of the magnetic field intensity and a correlation between

(a) Field intensity and sun spot intensity.

(b) Field intensity and Evershed effect (or Doppler effect due to solar atmospheric drift.

(c) Change in component or satellite line intensities and Zeeman effect in the sun spot spectrum.

(d) Behaviour of the lines in sun spot fields and in the general magnetic field of the sun.

Mr. King suggests a program of observations when the sun spot maximum returns and outlines the following working program:

1. That accurate determinations of field-strengths by a uniform method be made for each spot used.

2. That the whole spectrum be photographed with the same spot and on the same day in as high orders and as far into the infra-red as possible.

3. That such series be obtained for several spots on different dates and that all plates be photometrically standardized.

4. That the spots be photographed as near as possible to the centre of the sun's disk, and that a quantitative study be made of the influence of angle on the Zeeman patterns of spot lines of different intensities and different Zeeman separations in order that corrections may be applied.

5. That extraordinary precautions be taken to obtain a pure spot spectrum by eliminating scattered light in the instrument and by diminishing as far as possible the effects of atmospheric scattering and bad seeing.

The investigation on the Zeeman effect in solar spectral lines is complicated by the Doppler shift in the lines due to the motion of the sun as a whole or to local motions of vapours at the surface (Evershed effect). Where Doppler shifts are dominant, however, in either solar or stellar motions it has become a fruitful spectroscopic source of information not only of solar conditions but especially of the conditions associated with the stars, the nebulae and the planets.

Investigations on the Temperature, Constitution, Magnitude, Distance and Motions of Stars, Nebulae and the Matter of Interstellar Space.

No attempt will be made to present a complete outline of the

recent progress in this extensive realm. A brief reference must suffice. We may record in the first place the still intensive use of the Doppler shift of the spectral lines in the light from stars to determine their radial velocities, and other information. To the radial velocity of distant nebulae is also ascribed the Doppler shift observed in their spectral lines. The predominance of the shift towards the red end of the spectrum in their light forms a basis for the conclusion that the universe is expanding. A correlation of the radial velocities with the distances of the nebulae, deduced from the intensities of their light, gives rise to the suggestion that the greater outward radial velocities are associated with the more distant nebulae. In the light from some stars where no actual shift of the spectral line as a whole is detectable, there exists a width in the spectral line and the reason has been ascribed to the internal motion and the rotational velocities of the stars. Rotational velocities of many stars have been measured, where both the emission and absorption lines exist in the spectrum and a definite but somewhat irregular change in the structure and intensity of the lines with time is observable. These variations in intensity and structure are interpreted as due to expansion and contraction of a rotating atmosphere about these stars.

The methods of the determination of the constitution and temperature of the sun and stars by spectroscopic analaysis of their light has been well established for many years. These methods are being extended in keeping with the progress made in spectroscopy of light from terrestrial sources.

For example, there has been the organization of almost all spectral lines and bands into series with a systematic relationship between the components of the series, and the characteristics of the series have afforded much evidence on the atomic structure of the elements, the interrelationships of the elements and the conditions of the emitting sources. In this work the series of spectral lines of the light from the primary element hydrogen has been of special significance. Five series of lines, the Lyman or ultra-violet series, the Balmer or visible spectral series,and the Paschen,Brackett and Pfund series in the infra-red, have been recognized. Their characteristics are definite and their numerical relationships simple. Extensive work has been carried out recently at Mount Wilson in the identifi-

cation and comparison of the Paschen and Balmer series of Hydrogen emission lines in several stars. The structure and intensity of the lines in the two series has been photometrically determined and compared. From the relative intensities of the two series the energy states associated with the production of the lines are deduced, and it is shown that conclusions may be drawn concerning the physical conditions in the hydrogen atmosphere and the effective temperature of the photosphere of the stars. Similar methods of determining the structure and intensity of absorption lines have been used to determine the intensity of interstellar calcium lines, and if applied to absorption lines of other elements, they should give further information on matter in interstellar space.

The Atmospheric Conditions of the Planets.

The possibility of the existence of life on other planets such as we experience is of absorbing interest even to those who have but a passing interest in astronomical matters. This would apparently require conditions of temperature and enveloping atmosphere not too greatly different from the conditions associated with the earth. Since early investigations have indicated similarities in the earth and Mars in temperature, density and apparent surface markings with their seasonal changes, more intensive investigations have been made in recent years on Mars than on the other planets, especially in respect to its atmosphere. Two very important constituents of our atmosphere for the support of life are water and oxygen. Spectroscopic evidence of the existence of water in the form of vapour, and direct observational evidence of its existence in liquid and solid form had been fairly definite. However, spectroscopic evidence of the presence of oxygen in the atmosphere of Mars has been very conflicting. The amounts indicated from the results of various spectroscopic investigations ranged from a negligibly small amount to about 16 per cent. as much oxygen above unit area on Mars as on the earth. During the autumn and winter of 1932-1933, W. S. Adams and T. Dunham, Jr., at Mount Wilson Observatory, using a grating spectrograph attached to the 100-inch telescope, made a careful investigation of the Doppler shifts and absorptions by the atmosphere of Mars of about thirty oxygen lines originating, of course, in the sun. The results were published during the past year.

The conclusion was reached that the amount of oxygen in the atmosphere of Mars is probably less than 0.1 per cent. of that in the earth's atmosphere over equal areas of the surface.

If, then, the amount of oxygen in the atmosphere of Mars is negligible, the existence of life on Mars such as we know it on the earth is precluded. The uncertainty of the existence of oxygen which arose from the conflicting results of former investigations inspires a critical study of the evidence which has been presented for the existence of water and water vapour on Mars. If the method of Adams and Dunham is used, the evidence is masked greatly by the water vapour in the earth's atmosphere and is therefore less delicate. While this evidence then is of itself not decisive, the existence of water vapour receives support from the presumptive presence of water in the liquid and solid form from the season's changes in the polar ice cap and the daily rise in temperature of the planet above the freezing point of water, as deduced from measurements of its radiation.

The illustrations of the services of physics in astronomy show that physics must supply the foundation for the interpretation of observations made in astronomy. Research in physics then must ever be the guide and contemporary of research in astronomy.

ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The annual meeting of the Royal Astronomical Society of Canada was held in the Physics Building of the University of Toronto, on January 8th, 1935, the president, Dr. Lachlan Gilchrist, in the chair.

The minutes of the last annual meeting were taken as read. The secretary, Mr. R. A. Gray, presented his report, which was approved on motion of Mr. J. E. Maybee, seconded by Mr. F. Troyer. Mr. Gray also gave the librarian's report, which was passed. In the absence of Mr. J. H. Horning, the general treasurer, the financial report was read by Mr. Gray. Attention was drawn to the fact that a deficit appears for the year's operation. This was referred to the council for consideration.

It was moved by Mr. E. J. A. Kennedy, seconded by Mr. Gray, that the report be adopted, with the request that a special statement be attached showing the outstanding amounts due from those centres which had not paid their fees.

Mr. R. S. Duncan was present and gave the curator's report of the use made of the property—telescopes, slides, etc.,—belonging to the Society. After some discussion, Mr. S. C. Brown moved, Mr. Duncan seconded, that a maximum period of three months be established as the duration of the loan of any of the Society's telescopes.

The scrutineers appointed by the meeting then reported that 133 ballots were received, showing that the nominations were unanimously approved, and the president therefore declared the following duly elected:

Honorary President—The Hon. Leonard J. Simpson, M.D., Minister of Education for the Province of Ontario.

President—Lachlan Gilchrist, M.A., Ph.D., Toronto.

First Vice-President—R. E. DeLury, M.A., Ph.D., Ottawa.

Second Vice-President—J. A. Pearce, M.A., Ph.D., Victoria.

General Secretary—R. A. Gray, B.A., 198 College St., Toronto.

General Treasurer—J. H. Horning, M.A., Toronto.

Recorder—E. J. A. Kennedy, Toronto.

Librarian—R. A. Gray, B.A., Toronto.

Curator—R. S. Duncan, Toronto.

Council—D. S. Ainslie, M.A., Ph.D., Toronto; F. Napier Denison, Victoria, B.C.; Miss A. Vibert Douglas, Ph.D., Montreal; Wm. Findlay, Ph.D., Hamilton; E. A. Hodgson, M.A., Ph.D., Ottawa; P. M. Millman, M.A., Ph.D., Toronto; E. H. McKone, B.A., B.Paed., London; J. Patterson, M.A., Toronto; John Satterly, M.A., D.Sc., Toronto; L. A. H. Warren, M.A., Ph.D., Winnipeg.

The thanks of the Society were tendered to the auditors, Mr. J. E. Maybee and Mr. A. R. Hassard, for their work during 1934, and on motion they were elected for another year. They made some suggestions, which were referred to the council for consideration.

E. J. A. KENNEDY, *Recorder.*

REPORT OF THE LIBRARIAN

Since the last annual meeting negotiations for the transfer of the more technical portion of the library of the Society to the David Dunlap observatory were continued. The committee appointed by the council to consider Dr. C. A. Chant's memorandum, met and made the following recommendations:

1. That the technical portion of the Society's library, as designated in the appended list, be loaned to the observatory.

2. That the observatory shall give the Society through the librarian of the university, a receipt for the various publications loaned.

3. That the observatory shall undertake to replace any publication that may be lost or damaged.

4. That for the present the Society shall continue at its discretion to bind the current publications as the volumes are completed.

5. That a list of the publications loaned shall be supplied to the librarian of the university who may obtain for consultation any of the publications, in the same manner as is followed in the departmental libraries of the university. It is understood that, as proposed by Professor Chant in his memorandum, the members of the Society shall have access to the entire library of the observatory on the same conditions as members of the university.

6. That the loan be for three years, at the end of which time it may be renewed and the terms revised.

7. That this agreement with the observatory shall become valid when it is approved by the Board of Governors of the University.

The secretary forwarded to President Cody a copy of the above report and a reply was received from the Bursar of the University, as follows: 24 February, 1934.

The General Secretary,
Royal Astronomical Society of Canada,
198 College St., Toronto

Dear Sir,—

Your letter, of date the 3rd instant, addressed to President Cody, was laid before the Board of Governors at their meeting on the 22nd instant.

I am directed to inform you that the Board cordially accept the proposal of the Royal Astronomical Society to place on loan with the David Dunlap observatory the technical portion of the Society's library, as designated in the list appended to your letter, on the terms indicated in your communication.

The Board desire me also to convey to your Society their appreciation of this co-operation with the observatory in regard to forming a working library for the latter, and their sense of the benefits which will result to all concerned.

Yours very truly,

(Signed) F. A. MOURÉ, *Bursar.*

In consequence of the acceptance by the university of the technical portion of the library under the terms specified, about three and a half tons of bound volumes and pamphlets were forwarded to the Dunlap observatory. The space vacated is now being utilized to make the portion of the library remaining at the College street rooms more easily accessible to the members. About a dozen new books on astronomy were added to the library during the year, notice of which appeared from time to time in the JOURNAL.

In the past, owing to the nature of the subject, books have been borrowed from the library and have been retained at the pleasure of the borrower. In the future, if a book is retained beyond a month, the assistant librarian will notify the borrower that the book should be returned. If, however, the book should not be asked for, a renewal for another month may be granted.

A partial list of the publications loaned by the Society to the David Dunlap observatory was printed in the JOURNAL for April, 1934 (page 169).

Additions to the library during the year include periodicals from:

Canada and the Empire	173
The United States	192
Other countries	167
Total	532

Number of books borrowed by members	101
The JOURNAL is sent in exchange to	
Places in the Empire and Canada	40
" the United States	50
" other countries	51

R. A. GRAY, *Librarian.*

REPORT OF THE ASSISTANT SECRETARY

MEMBERSHIP OF THE SOCIETY

The membership of the Society on December 31, 1934, as shown by the reports of the different centres, was as follows:

	1933	1934
Toronto	173	174
Ottawa	62	62
Victoria	112	119
Montreal	111	107
Winnipeg	69	73
London	60	52
Hamilton	56	54
Vancouver	67	73
Edmonton	40	54
Members at large	108	133
Total	858	901
Subscribers to JOURNAL	68	65

E. M. BUDD, *Assistant Secretary.*

REPORTS FROM THE SECRETARIES OF THE CENTRES

TORONTO CENTRE

The membership of the Toronto centre is made up of:

Those resident in Toronto	123
Life members	8
Non-resident members	43
Total	174

At the beginning of the year the number was 173, there is therefore a gain of 1; 22 new members were elected during the year, so that 21 members dropped out. We regret this annual loss and at a recent meeting of the Toronto council the matter was referred to a membership committee which was there appointed.

The interest in the regular meeting of the Society was well sustained throughout the season, 13 meetings being held. The subjects and speakers are given on the attached sheet.

The officers and members of the council for the year 1935 were appointed at a special meeting on December 11 (they appear in another part of this issue).

During the year thirteen meetings were held. The subjects and speakers were as follows:

Jan. 30—R. A. Gray, B.A.: Whence does the sun derive its heat? E. J. A. Kennedy: Neptune.

Feb. 13—Rev. C. H. Shortt: Some notes on Japan; B. Laing: Uranus.

Feb. 27—H. F. Balmer, M.A.: A man-made universe, the optical planetarium; S. C. Brown: Pluto.

Mar. 13—Prof. H. A. McTaggart: Peculiarities of Vision: J. A. Robins: Asteroids.

Mar. 27—J. R. Collins: The New Background of Science, by Sir James Jeans (review); H. G. Duncalfe: The twin elliptic pendulum (demonstration).

Apr. 10—Popular science motion pictures: Communing with the heavens; Beyond the microscope; The romance of the skies; Liquid air.

Apr. 24—Dr. C. A. Chant: Are the stars infinite in number? K. O. Wright, Virgo.

May 8—A. F. Miller, charter member: The inception and founding of the Royal Astronomical Society of Canada; H. G. Duncalfe: Exhibition of sundial of unique type.

Oct. 16—A. R. Hassard; J. R. Collins; S. C. Brown; F. L. Troyer: Summer observations and experiences.

Oct. 30—Dr. P. M. Millman: Modern meteoric research—the ideal field for the amateur, with demonstration of the meteoric shower projector.

Nov. 13—W. E. W. Jackson, M.A.: Locating the earth's magnetic poles; F. L. Troyer: A newscast of astronomical items.

Nov. 27—Prof. D. S. Ainslie: Laboratory sources of light for spectroscopic investigation.

Dec. 11—D. S. Archibald, Dominion Meteorological Service: A recent survey of some of the European Meteorological Services.

The sum of $299.00 has been received in fees by the Toronto section during the year.

E. J. A. KENNEDY, *Secretary.*

Edmonton Centre

During the year the Edmonton centre held seven general meetings as well as the annual meeting and several council meetings.

Jan. 13—Prof. Keeping: Determining stellar distances.
Feb. 15—Dr. E. H. Gowan: Spectroscopy and its application to astronomy and astrophysics.
Mar. 8—A. B. McKim: Comets.
Apr. 12—Dr. E. H. Gowan: The telescope,
May 16—W. E. Harper of the Dominion Astrophysical Observatory at Victoria: The construction of the observatory and the work carried on there, illustrating his address with lantern slides.
Oct. 11—Robt. Chambers: Navigation.
Oct. 8—Prof. S. Smith: The atom.
Dec. 13—Annual Dinner Meeting: F. S. Simpson: Some astronomical suggestions.

It has been the custom at general meetings to have a talk on some constellation of the month. Dr. Campbell has also kindly given a short talk on the Handbook with reference to points of special interest during the month, and on clear nights the telescope has been set up for observation.

Our present membership has increased over last year in spite of resignations and removals.

H. H. Beach, *Secretary.*

Hamilton Centre

No annual report was received from the Hamilton centre. The reports of the nine regular meetings, together with the officers for 1935, will be found in another place in this issue of the Journal.

London Centre

During 1934 the London centre held eight regular meetings and two picnics, at which telescopic observations were carried on.

At the regular meetings the following subjects were discussed:

Jan. 12—Dr. H. S. Wismer: Fragments of astronomical bodies.
Feb. 9—Rev. W. G. Colgrove: Some of the figures given in the book, "The Solar System".
Mar. 9—F. H. Coates: Demonstration of the use and nature of a seismograph; E. H. Anundsen: Address on the sun.
Apr. 13—F. H. Coates: The Great Pyramid at Gizeh—Man's earliest observatory.

May 11—H. R. Kingston: The earth as an astronomical body.
June 8—A picnic and observation meeting was held at the home of the president.
Sept. 14—A similar outing was held at the country home of Mr. J. C. Higgins.
Oct. 12—Dr. F. W. Tamblyn: Astronomy in literature. An observation period from the roof of London Life building was conducted by Dr. Kingston.
Nov. 9—Prof. J. W. Russell: Earthquakes.
Dec. 13—Annual meeting and social evening.

There was one council meeting held at Mr. Gunn's home on January 3, 1934, at which every member was present and the programme for the year was arranged.

(The officers for 1935 are given in another place in this issue.)

N. MORRIS, *Secretary*.

MONTREAL CENTRE

During the 1933-34 session there were eight meetings, as follows:

Nov. 2—The Secretary: Novae—Nature's greatest cataclysms.
Nov. 15—Joint meeting with Sigma XI: Theory of numbers.
Dec. 6—Dr. W. H. Watson: The electrical properties of light.
Jan. 18—Julian C. Smith: The Mt. Wilson Observatory.
Jan. 29—Joint meeting with McGill Physical Society; Abbe Georges Lemaitre: Cosmic rays.
Feb. 9—Meeting of Engineering Institute of Canada; Dr. R. K. Young: Engineering features of David Dunlap telescope.
Mar. 15—H. F. Hall, F. DeKinder, E. Russell Paterson: The solar system.
Apr. 19—The Secretary: Telescopes—great and small.

In April it was decided to form a small telescope committee to be in charge of the observational activities of the Society during the spring and summer months. The telescope was transferred, by kind permission of the Sun Life Assurance Company of Canada, to their head office building where balcony accommodation was made available, and weekly meetings, more or less, were held and greatly appreciated by members attending.

There are now on the register 123 members, and special mention is thought fitting of the loss to the Society in the death of its former president, Mr. Justice E. E. Howard, and of its 1st vice-president, Dr. Daniel A. Murray.

A. VIBERT DOUGLAS, *Secretary*.

Ottawa Centre

During the year there were eight emergency meetings of the council.

Our membership at the beginning of the year was 64. During the year three resigned and three were transferred to the Toronto centre. Seven were admitted to membership, three of whom have their membership dated as from Jan. 1, 1935, so that we concluded 1934 with a membership of 62.

In July a special note was received from Dr. P. M. Millman, announcing plans for observing the perseid meteors in August. At an emergency meeting of the council it was decided to send out a notice of Dr. Millman's programme to all members of this centre. Observations were made from the roof of the observatory on two nights, Aug. 11-12 and Aug. 12-13, and results forwarded to Toronto on forms provided for the purpose. Again on Nov. 14-15 and 16-17, Leonid meteors were observed from the observatory and from Franktown, but only from the observatory were results obtained.

As in previous years, the Saturday evening programme of the Dominion observatory were sent to all members of the centre through the kindness of the director, Mr. R. M. Stewart.

M. M. Thomson, *Secretary*.

Vancouver Centre

The Vancouver branch of the Society has had a very successful year. Its programme has been particularly interesting and the meetings have been very well attended.

At the beginning of the year the number of members was 68. During the year six new members were elected, and one member withdrew. The actual number of paid-up members, however, is about half this number.

Before reporting on the activities of the Society for this year, I should like to refer to the passing of Mr. N. H. Hawkins, an officer of this year's council and a valued worker in the interests of the Society.

Seven regular meetings were held. The programmes were as follows:

Jan. 9—Prof. W. H. Gage: Variable stars.
Feb. 13—Dr. F. S. Hogg: Meteors.
Mar. 13—Dr. W. Ure: Chemistry in astronomy.
Apr. 10—Members' Night. Discussions as follows: H. A. Newton: Use of the Observer's Handbook; Prof. A. B. Lighthall: Survey of constellations; J. Teasdale: Observations for amateur astronomers; C. A. McDonald: Book review.

Preceding this programme, a dinner was held at Union College.

Oct. 9—Dr. A. E. Hennings: Clouds and weather phenomena.
Nov. 20—Dr. J. A. Pearce: Our galaxy: a typical spiral nebula.
Dec. 11—Annual meeting. Election of officers.

At some of the above meetings, Mr. Paul Sykes, Mr. C. A. McDonald and Mr. N. H. Hawkins assisted with short addresses.

Three special observation meetings were held during the summer months, and were made possible through the kindness of Mr. J. Teasdale, Mr. H. C. B. Forsyth, Mr. C. E. MacKenzie, and Mr. H. P. Newton.

In addition to the above meetings, the officers and council of the Society held four council meetings.

During the year the Society received a visit from Dr. J. S. Plaskett, to whom, on his retirement as director of the Dominion Astrophysical Observatory at Victoria, the local branch extends its very best wishes. We were also pleased to have with us at one of the summer meetings, Mr. J. R. Collins of Toronto.

The secretary wishes to thank members and friends of the Society for their co-operation throughout the year.

(The officers for 1935 will be found in another place in this issue.)

WALTER H. GAGE, *Secretary*.

VICTORIA CENTRE

Membership

Total membership as at December 31, 1933	112
New members secured during 1934	34
	146

Less

Members deceased	2	
" transferred	3	
" resigned	8	
Cancellations for non-payment of dues	14	
		27
Total membership as at date (1934)		119

This membership is made up as follows:

Life members	2
Honorary member	1
Victoria City members	73
Out-of-town members	35
Junior members	8
Total	119

Meetings. During the year there have been held 11 regular and 8 council meetings. In addition, there were 10 meetings held in connection with the summer course. This makes a total of 29 meetings held during the year 1934.

General. From a financial standpoint the year may be considered a successful one for not only have we been able to remit in full to Toronto the whole of the 1933 dues collected, but also, in addition, a further $40 which was outstanding in respect of the 1932 dues.

The series of lectures delivered at the regular meetings during the year have been of a high order and consequently the attendance at such meetings has been most gratifying. The summer course this year was a phenomenal success as all know who attended the same. As a result I am inclined to the opinion that in future these summer courses, coupled with the telescope-making section, will be among the prime factors not only for the securing of new members, but also of maintaining that measure of sustained interest in the affairs of the centre by the members at large which is so essential to its future welfare and prosperity. As a matter of fact, and by way of confirmation of this viewpoint, I may state that the records

show that of the 34 new members secured this year, 20 of them joined as the direct result of the holding of the summer course.

Finally, I may state that there are only 16 members who are in arrears with their 1934 dues. In accordance with the constitution, these will be automatically dropped unless such dues are paid in the near future. I need hardly state that it is the hope of the council that this course will not be necessary.

In conclusion I wish to take this opportunity of expressing to the members at large and to the members of the council in particular my very best thanks for the kindness and courtesy which has been extended to me during my term of office, which, I assure you, has been much appreciated. HORACE E. MOORE, *Secretary*.

WINNIPEG CENTRE

During the year 1934 there have been nine regular meetings, beside a special one at which the guest of honour was our honorary president, Dr. J. S. Plaskett.

January—L. T. S. Norris-Elye: The telescope.
February—A. V. Pigott: New ideas of the universe.
Mar. 14—W. H. Darracott: The constitution of the stars.
Mar. 28—Prof. G. H. Herriot: Locating one's position from the stars.
April—Members' Night. Mrs. E. L. Taylor: Things known in immensity; C. E. Bastin: The solar system; A. W. Megget: Celestial events of the month; G. P. Morse: Astronomy and aviation.
May 21—An Observation Meeting, four telescopes in use, under the direction of A. W. Meggett, D. R. P. Coats and L. T. S. Norris-Elye, two refracting and two reflecting.
May 29—Dr. J. S. Plaskett (guest-speaker): The galaxy.
October—President Coats and Dr. L. A. H. Warren used slides (social evening), illustrating the Perseids, and also mechanical ones, instructive and interesting.
November—Right Rev. T. W. Morton: The elephant and the tortoise.
Dec. 12—D. R. Coats (presidential address): Taking stock of the universe.

One year ago our membership was 69. There have been two resignations and three deaths during the year. Nine new members joined the Society, making the present membership 73.

There were three meetings of council on the evenings of Dec. 21, 1933, Sept. 26 and Dec. 12, 1934.

JEAN C. HOWEY, *Recorder*.

FINANCIAL STATEMENTS, 1934

I. GENERAL TREASURER

GENERAL ACCOUNT

Receipts		Disbursements	
Balance, 1933	$1,026.11	Publications	$2,434.07
Grants	2,270.00	Public meetings	85.60
Fees	1,384.50	Library	24.60
Publications	351.90	Discount	.12
Interest and exchange	109.78	Stamps and stationery	257.93
Stamps and stationery	27.61	Salary, Asst. Secretary	660.00
		Janitor	12.00
		Rent	120.00
		Grants:	
		Montreal $ 85.00	
		Ottawa 44.50	
		Toronto 127.00	
		London 60.00	
		Winnipeg 38.00	
		Edmonton 42.50	
		Victoria 95.50	
		Vancouver 20.50	
			$ 513.00
		Miscellaneous	18.93
		Bank balance	1,043.65
	$5,169.90		$5,169.90

LIFE MEMBERSHIP ACCOUNT

Receipts		Disbursements	
Balance, 1933	$199.31	Bank balance	$270.69
Life members	50.00		
Bank interest	5.88		
Bond interest	15.50		
	$270.69		$270.69

BUILDING FUND ACCOUNT

Receipts		Disbursements	
Balance, 1933	$473.71	Safekeeping of bonds	$ 2.00
Bank interest	12.81	Balance	729.52
Bond interest	207.50		
Bonus on bond exchanged	37.50		
	$731.52		$731.52

SOUTHAM PRESS FUND ACCOUNT

Held in General Bank Account

RECEIPTS		DISBURSEMENTS	
Balance, 1933	$199.11	Balance	$268.11
Bond interest	65.00		
Bank interest	4.00		
	$268.11		$268.11

J. H. HORNING, *General Treasurer.*

Audited and found correct, January 3, 1935.

A. R. HASSARD, –
J. EDW. MAYBEE – *Auditors.*

MEMO—BONDS HELD BY IMPERIAL BANK FOR SAFE-KEEPING

Description of Bond	Face Values	Date of maturity	Rate	Yearly Interest	Dates of Interest
Building Fund					
1. Interim Br. C_4E32591	$1,000.00	1949	3½%	$37.50	Oct. 15, Apl. 15
2. D. of C. N_1E029210	1,000.00	1941	5%	50.00	May 15, Nov. 15
3. Can. Per. Mge. L15591	500.00	1935	5%	25.00	Jne. 1, Dec. 1
4. Can. Per. Mge. L15593	500.00	1935	5%	25.00	Jne. 1, Dec. 1
5. Can. Per. Mge. L13275	500.00	1936	5%	25.00	Jne. 1, Dec. 1
6. Can. Per. Mge. L20932	500.00	1937	5½%	27.50	Jne. 1, Dec. 1
	$4,000.00			$190.00	
Life Membership					
1. D. of C. R_2TA083071	$ 100.00	1943	5%	$ 5.00	Apl. 15, Oct. 15
2. D. of C. R_2TA083072	100.00	1943	5%	5.00	Apl. 15, Oct. 15
3. Can. Per. Mge. L20933	100.00	1937	5½%	5.50	Jne. 1, Dec. 1
	$ 300.00			$ 15.50	
Southam Press Fund					
1. D. of C. N_1A013817	$ 100.00	1936	5%	$ 5.00	May 15, Nov. 15
2. D. of C. N_1A013818	100.00	1936	5%	5.00	May 15, Nov. 15
3. D. of C. N_1A013819	100.00	1936	5%	5.00	May 15, Nov. 15
4. D. of C. N_1E008218	1,000.00	1941	5%	50.00	May 15, Nov. 15
	$1,300.00			$ 65.00	
Totals	$5,600.00			$270.50	

II. TREASURERS' REPORTS OF CENTRES

1. TORONTO CENTRE

Receipts		Disbursements	
Balance, Jan. 1, 1934	$203.23	Rent	$ 52.00
Grant from General Council	127.00	Printing notices	26.84
		Advertising	10.20
		Treasurer, stamps	1.27
		Gen. Treasurer, postage	17.26
		Expenses, Apr. 10th meeting	2.09
		Balance to 1935	220.57
	$330.23		$330.23

2. MONTREAL CENTRE

Receipts		Disbursements	
Balance, Oct. 15, 1933	$232.31	Remitted to Gen. Treas.	$198.00
Members fees, 99 at $2.00	198.00	Typing and mimeographing	13.74
Grant from Gen. Treasurer	85.00	Expenses re meetings	20.00
Donation	8.00	Postage	15.35
Interest on bank deposits	8.77	Stationery	2.57
		Sundry general expenses	6.95
		Telescope expenses	6.50
		Balance, Oct. 15, 1934	268.97
	$532.08		$532.08

3. OTTAWA CENTRE

Receipts		Disbursements	
Bal. in bank, Dec. 20, 1933	$141.66	Amt. sent to Head Office	$ 89.00
Amount collected in dues	71.00	Postage, exchange	.25
Cheque from Head Office	44.35	Flowers	5.00
Interest on deposits	2.45	Balance in bank	165.21
	$259.46		$259.46

4. HAMILTON CENTRE

Receipts		Disbursements	
Balance from 1933	$ 14.18	Cheque to Toronto	$ 76.00
Membership fees	104.00	Lecture hall rent	24.00
Donation	3.00	Lecturer's expenses	2.50
Loan	20.58	Stamps and notices	12.55
		Printing notices	19.08
		Bank balance	7.63
	$141.76		$141.76

5. LONDON CENTRE

Receipts		Disbursements	
Balance from 1933	$ 91.64	Expenses, annual meeting	$ 2.00
Membership fees	107.00	Honoraria: C. Ryckman, $2.00; H. Billings, $5.00	7.00
Receipt from Gen. Treas	60.00	Stationery	.35
Bank interest	3.60	Flowers	3.75
		Stamps, money orders, exchange	2.12
		Picnic expenses	5.25
		Secretarial expenses	12.89
		To Gen. Treas	107.00
		Bank balance	121.88
	$262.24		$262.24

6. WINNIPEG CENTRE

Receipts		Disbursements	
Balance from 1933	$ .07	Advertising	$ 24.60
Grant from Gen. Treas	38.00	Printing	5.83
Subscription fees:		Honorarium	7.00
1932	2.00	Lantern operation	14.00
1933	28.00	Postage	11.43
1934	58.50	Flowers	18.35
1935 advance	4.00	Fees to Gen. Treas	55.00
Subscriptions to wreath	12.50	Bank bal. Dec. 12, 1934	7.75
Bank interest	.87		
Exchange	.02		
	$143.96		$143.96

7. VANCOUVER CENTRE

Receipts		Disbursements	
Balance	$ 27.78	Remittance to Toronto	$ 20.50
Fees received:		Cost of star slides	7.11
1933	2.00	Dr. Hogg's lecture	7.50
1934	52.00	Secy's postage and cards	2.00
1935	14.00	Wreath, Mr. Hawkins	5.00
1936 to 1938	6.00	Exchange, Toronto cheque	.15
Grant from Toronto	20.50	Printing programmes	7.42
Bank interest	1.13	Dr. Pearce's lecture	7.50
		Balance	66.23
	$123.41		$123.41

8. VICTORIA CENTRE

Receipts		Disbursements	
Balance, Dec. 8. 1933	$ 25.47	Rent	$ 27.50
Dues collected	181.00	Conversazione expenses	6.05
Donations received	13.00	Furniture, fixtures	12.00
To fees from non-members (summer course)	9.00	Library expenses	8.76
Grant from Toronto	99.50	Lecturer's ex. (Dr. Shrum)	5.00
Bank interest	1.65	Summer Course expenses	5.30
		Printing and stationery	22.95
		Dues to Toronto:	
		1932	40.00
		1933	175.00
		Janitor	2.50
		Postage	17.19
		Sundries	4.45
		Bank balance	2.92
	$329.62		$329.62

9. EDMONTON CENTRE

Receipts		Disbursements	
Membership fees (1934)	$ 85.00	Remittance to Parent Society (including exchange)	$ 85.15
Grant from Parent Society	42.35	Postage	6.40
Bank interest	2.48	Stationery and Secretary's supplies	11.79
Balance from 1933	23.44	Lecture expenses	2.45
		Refreshments and janitor service	11.00
		Reporter at dinner	.75
		Balance on hand	35.73
	$153.27		$153.27

THE MOON AND THE WEATHER*

By E. G. Hogg

THERE is a widespread belief that the moon can directly influence the weather—that an intimate relation exists between the weather and the phases of the moon—that changes of the moon and changes of the weather go together. This belief, which comes down to us from ages less enlightened than our own, mainly centres on the question of rainfall, and doubtless had its origin in remote times among the classes engaged in agriculture, to whom rain or its absence spelt, then as now, the difference between the failure or success of their crops. As a matter of fact, the "changes" of the moon are continuous, but popular fancy ascribes to certain definite aspects of our companion, viz., the new, full, first and last quarter, the supposed lunar influence on rainfall, probably because these appearances can be tersely described and recognized by all, while it is not easy to find words which will readily evoke a picture of the moon when it is, say, half-way between the full and last quarter. These "changes" are, for the most part, ignored by the weatherwise; at any rate very little influence appears to be attributed to the moon when its aspect is other than one of the four mentioned above.

There is probably no question in which people generally take so deep an interest as the weather; in all climes and in all ages this has been the case, and we may be sure that if a definite correlation existed between the phases of the moon and the weather it would have been detected long ago and employed in a rational manner in weather prediction. No meteorologist of any standing can, however, be found who will assert that such a relation exists. If he were acquainted with them he might be inclined to quote the following lines from "Notes and Queries," September 23, 1882:—

> The moon and the weather
> May change together;
> But change of the moon
> Does not change the weather.
> If we'd no moon at all
> —And that may seem strange—

*Written for *The Christchurch Press* and published in "Astronomical Notes" of the New Zealand Astronomical Society.

We still should have weather
That's subject to change.

It should be borne in mind by those who seek to infer from the state of the weather at new moon what weather will prevail during the ensuing lunation that when it is new moon in any locality it is new moon for all the earth, and therefore that any influence this phase exerts must be world-wide. Furthermore, we know that storms travel over the earth's surface, hence if any change of weather is determined by a particular aspect of the moon it must fail to suit it in places over which the storm has already passed, or which it has not yet reached.

A search among such literature as is accessible here has revealed very little on the subject of the moon and weather changes, but it appears that in 1848 a certain Mr. Forster read before the Royal Astronomical Society a paper in which he strove to prove that if a new moon fell on a Saturday three weeks' rain followed, and he argued that observations extending over 80 years supported his contention. This is the only definite attempt to prove that the moon influences the weather known to the present writer, and it would appear that Mr. Forster has hardly done more than give a somewhat ludicrous twist to the whole matter.

The moon affects the earth gravitationally, causing certain motions of that body and also producing tides in its ocean and atmosphere. The tidal wave in our atmosphere is, however, far too minute to be an effective cause in any known meteorological phenomenon. The moon reflects a very small amount of heat to the earth, especially when it is full, and it is held by some that clouds have a tendency to disappear under full-moon, and they find in this reflected heat an adequate explanation of the matter. Humboldt, in his Personal Narrative, speaks of this dissipation of clouds under full-moon as well known to the pilots and seamen of Spanish America and Sir John Herschel states that he had from his own observation arrived at a similar conclusion. It must, however, be added that some time ago Professor Loomis examined the cloud records taken at Greenwich Observatory over a period of seven years, and found that they did not support the views of Humboldt and Herschel.

It does not, however, follow that because the moon is ineffective

in producing weather-changes, we cannot learn anything of value about the condition of our atmosphere from the appearance our companion may from time to time present. On the contrary the moon often supplies us with information from which we may make a useful forecast of the weather to be expected in the immediate future, especially when used in conjunction with barometer readings. There is much weather-wisdom garnered up in the Latin adage, "Pallida luna pluit; rubicanda flat; alba serenat," i.e., a pale moon indicates rain; a red moon, wind; a clear moon, fair weather. There is another warning sign the moon often gives us. Many who are acquainted with the doggerel lines:

> Old Bette's joints are on the rack;
> Her corns with shooting pains torment her,
> And to her bed untimely sent her,

may not be aware that in an earlier part of this effusion we have as a prognostication of bad weather the following couplet:

> Last night the sun went pale to bed,
> The moon in halos hid her head.

To these lunar halos modern meteorology ascribes some value in weather prediction.

It is a matter of common observation that, concentric with the moon, occur illuminated rings with angular radii of 22 or 46 degrees; these halos show the prismatic colours, the red being nearest the moon. Their formation is due to the refraction of the moon's light as it passes through a cloud composed mainly of prisms and thin plates of ice situated at a height of 20,000 feet or more above the earth's surface. The cloud whose presence is disclosed by the halo is often the vanguard of an atmospheric disturbance leading to stormy weather. A lunar halo must not be confused with the corona which is often seen round the moon when a fleecy cloud comes between that body and the observer; the corona is of little significance in forecasting the weather.

This note may well conclude with an extract from a lecture on "The Tides," delivered by Lord Kelvin some 50 years ago, as it shows apparently that under very peculiar conditions the moon may affect the weather locally.

"There is one very interesting point I said I would endeavour

to speak of if I had time; I have not time, but still I must speak of it—the influence of the moon on the weather. 'We almost laugh when we hear of the influence of the moon on the weather,' Sir F. Evans said to me, 'but still there is an influence.' Gales of wind are remarkably prevalent in Torres Straits and the neighbourhood about the time of new and full moon. This was noticed by Dr. Rattray, a surgeon in the navy, in connexion with observations made by the surveying ship, Fly, during the three years 1841-44. Dr. Rattray noticed that at those times there was a large area of coral reef uncovered at the very low water of the spring tides, extending out some 60 or 70 miles from the land. This large area becomes highly heated, and the great heating of that large portion of land gives rise to gales at the full and change, that is, at the new and full moon. This indirect effect of the moon upon the weather through the tides is exceedingly interesting, but it does not at all invalidate the scientific conclusion that there is no direct influence, and the general effect of the moon on the weather—the changes in the moon and the changes in the weather and their supposed connexion—remains a mere chimera."

ASTRONOMY AS A HOBBY

By H. Boyd Brydon

(A radio talk over station CFCT, July 18, 1934)

Some of you who heard Mr. W. E. Harper speak last night on "July Skies" may remember that he mentioned the series of "Summer evenings with the Stars" which is being held on Monday evenings at Victoria College under the auspices of the Royal Astronomical Society of Canada.

These evenings are designed to introduce to you astronomy as a hobby.

A hobby is something more than a game, it is more than a recreation—a hobby not only refreshes us, makes our spare time enjoyable and lightens our daily tasks, it lifts us out of the rut of daily routine which at times bears heavily upon us all. A hobby, a real hobby, stimulates us and gives us a larger and happier life.

When Dr. Michelson, whose determination of the speed at which light travels is accepted by the scientific world, was preparing the extremely delicate apparatus and equipment to remeasure this speed with even greater precision, a friend asked him what was the use of wearing himself out by tackling afresh the hard and exacting work involved in the research. "Well," said Michelson, "first of all I shall have so much fun doing it." There is the true hobby, work done for the fun of doing it.

Hobbies are as varied as mankind. One paints, another collects stamps, a third studies the intricate theory of musical counterpoint, still another is a floriculturist, and so on. In their respective hobbies each finds recreation in its highest sense, mental and spiritual stimulation and happiness. A real hobby is one of the greatest blessings one can have. To be without a hobby is to be poor indeed.

Whether as a life-long study, as an occasional means of pleasantly passing some spare time, or as a delightful hobby, nothing can surpass the charm of astronomy.

Indeed, without at least some knowledge of astronomy one can hardly consider one's education even passably complete. As was well said recently by a writer in the *Times*, "To stare with uncom-

prehending eyes at the vast pageant of the heavens is childish. To desire no more argues insensibility."

But aside from the cultural value of astronomy, for the stars are signal lights that tell us the history of the universe, even a nodding acquaintance with them gives us pleasure akin to the pleasure of being able to recognize a flower or the song of a bird or a strain from a Beethoven sonata. But how much greater is the interest and enjoyment when we not only know their names and addresses, so to speak, but their family history, their characteristics, their resemblances and their differences; and when we can look forward to seeing them, as the earth swings them across our skies in its annual journey of 600,000,000 miles around the sun. Then they become friends. And they never intrude, never bore us, and never disappoint us. Always the more we know of them the more interesting they become.

"Yes," I fancy I hear someone say, "I'd like to know something about the stars, but I'm afraid it's over my head. I am no mathematician and, besides, the astronomy books I have seen are so dry and such difficult reading that I have neither the time nor the inclination to wade through them." Unfortunately, this is all too just a criticism of many works on astronomy. But astronomy is not the dry-as-dust, dull grind that such books make it appear. On the contrary, it is easy to understand, intensely interesting and a fascinating hobby within the reach of all, man, woman and child. Most emphatically one does not have to be a mathematician to enjoy astronomy as a hobby. Nor is expensive telescopic equipment necessary. However, any one with a reasonable amount of patience and perseverance, who is willing to spend from $15 to $20, can make an astronomical telescope better by far than those with which Galileo made the discoveries that did much to give to man a new vision of the universe and led Newton to his law of universal gravitation.

But even that is not necessary. A good opera glass or field glass will reveal many times the number of stars that can be seen with the naked eye, and give most interesting views of the tremendous craters, some of them over 100 miles across, which distinguish the surface of the moon.

With such a glass also, as Mr. Harper said, one can see the

satellites of Jupiter in their motions around that planet and some beautiful double stars. It is largely a question of learning to see and knowing where to look. The thrill of seeing such things for the first time is unforgettable and their fascination never wanes.

The attractions of astronomy are most varied. If detective stories intrigue you, with the triumph of the brainy detective in the final chapter; astronomy abounds with the best detective stories ever written, and they are true and there is no last chapter.

If you are interested in ancient tradition, the word-of-mouth history of prehistoric times, the stories of the old constellations, which date back many thousands of years, are well worth study. To the primitive peoples of the world a knowledge of the stars was necessary to the conduct of their lives. The stars were their almanac. By the procession of the stars they marked the seasons, and worshipped and gave thanks to them for the fruits of the earth and the success of their endeavours. They saw in these constellations the forms of their gods and heroes and sacred animals, pictures that with all our culture we cannot see.

METEOR NEWS

Observations relating to meteors and meteorites are cordially invited.

METEOR NEWS

Observations of the 1934 Geminids

Ontario was favoured with good weather on only one night during the annual return of the Geminid meteors. Observations were made from North Toronto on Dec. 13-14, 1934. The programme was started rather late because of the moon which was brightest at the beginning of the evening. Unfortunately, the writer was the only observer for the greater part of the programme and as several cameras were being exposed plate holders had to be reloaded frequently, thus rendering the visual observations somewhat sporadic. After 3.00 a.m., Miss F. S. Patterson, J. A. Robins and R. B. Laing observed visually.

The actual numbers of meteors observed are recorded in Table 1. The hourly rates, reduced to six observers, are plotted in Figure 1.

TABLE 1

E.S.T.	Geminids	Non-Geminids	
10.40-11.07	11	3	
11.14-11.45	8	1	
12.37- 1.10	19	2	
			haze
2.09- 2.41	12	3	light clouds
			sky half clouded
3.04- 3.30	8	2	
3.30- 3.50	8	2	
3.50- 4.10	11	4	
4.10- 4.30	2	1	clouding
Totals.....	79	18	

The number of Geminids appearing on Dec. 13-14, 1934, was certainly greater than was seen on Dec. 11-12 of the previous year. There were probably at least twice as many Geminids on the 1934 date as at this time the writer was both recording and plotting and

could watch the sky only about 60 per cent. of the time. The magnitude distribution of the observed meteors is given in Table 2. The average magnitude for the 1934 Geminids is a whole magnitude brighter than for those observed in 1933. The brighter moon and single observer in 1934 would probably account for most of this difference.

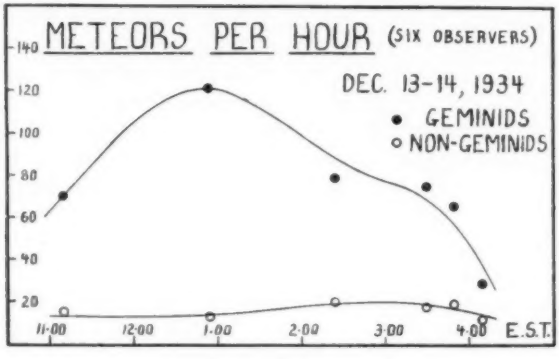

FIG. 1—The Geminid Meteor Rates, 1934.

TABLE 2

Mag.	−3	−2	−1	0	1	2	3	4	Totals	Mean Mag.
Geminids.....	2	7	8	14	17	17	12	1	78	0.8
Non-Geminids ..		1	1	3	4	4	5		18	1.3

ILFORD PLATES FOR METEOR PHOTOGRAPHY

Important advances in astronomical photography are very closely dependent upon improvements in the speed and grain of photographic emulsions. Nowhere is this truer than in meteor photography where increased efficiency cannot be attained by the use of larger instruments or longer exposures. The meteor photographer should always be on the lookout for plates which combine great speed with a fairly small grain.

The Ilford Company has recently standardized a fast panchromatic plate known as the Ilford Meteor. The writer, on testing some of these, found them to be well suited to meteor photography. They proved definitely superior, both in speed and grain, to others previously used. The characteristic of the Ilford Meteor plate is excellent speed in the blue with a remarkably small drop in sensitivity in the green and yellow-green and a maximum of sensitivity at about λ6000, the sensitivity falling off fairly rapidly to the red of this wave-length. The plate is particularly good for meteor spectrophotography but should also prove very fast in direct meteor photography. For photographing meteor spectra as far as λ6800 the Ilford Hα II plate is the best. This has a maximum of sensitivity at about the Hα line. Though about half a magnitude slower than Ilford Meteor it is very fast for a plate sensitive so far into the red. In Canada, Ilford plates can best be secured direct from the Canadian agents, W. E. Booth Co., 12 Mercer St., Toronto. Four to six weeks should be allowed in ordering the above specialized emulsions. P. M. M.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

Observations of the Aurora in Alberta

In a letter to Mr. J. R. Collins, of Toronto, dated December 15, 1934, Mr. H. B. Collier, a long-time member of the R.A.S.C., sends some interesting observations on the aurora. Mr. Collier lives at Viking, a short distance east of Edmonton. I am allowed to make the following quotation:

With the occasional auroral display here I have somewhat more favourable conditions for observation than in many parts of the Dominion. Much has been written on the aurora, and unless one has something to add to the accumulated facts, it is not very interesting to be told by me of the mere beauty of the display. However, there are one or two aspects of the aurora that may prove worthy of note. In most of the displays here I have noticed an arch with the "key" from 20 to 25 degrees above the horizon and approximately at the magnetic pole, which is at this point some 25 degrees east of north. This solid arch of light remains fairly constant, while the heavens above it act as the "curtain" for the moving display. Frequently shafts of light bombard the zenith with a veritable barrage, covering 90 degrees of the horizon, east and west. I have speculated upon the reflective influence of the Heaviside layer, but cannot believe that the electronic action of the aurora goes that high, unless, of course, it does so below the horizon. Yes, that is quite possible, similar to the mode of travel of the so-called short wave in radio. You might suggest to me some points for observation, that could be used as a basis for further study of this interesting phenomena.

Within the Aurora

Another reputed experience of being within an auroral display comes from Mr. H. Boyd Brydon, of Victoria, in a letter to him from H. T. Morgan of Calgary. The time is the night of August 26, 1932 (letter dated Sept. 3), and the following is an extract from the letter:

It was a perfect night for the star-gazer, and I had been out enjoying the observation. . . . At midnight I went into the house to get something to eat, after which I came out to continue the observation, when I found myself right in the midst of the Northern Lights—absolutely walking through the whole boiling. I became interested. I have seen them hundreds of times quite close but never before have I been absolutely in the midst of the phenomenon. For our own information we began to study the operation. The walls of atmosphere were rainbow-fashion, extending from north-east to north-west. It was of a

"nebula" colour running up into the sky. There was not a breath of wind stirring and yet this atmosphere was fluctuating into thick and thin masses hither and thither all along the line. I tried to solve this proposition. I walked 390 feet from the foot of my property to the top of the hill, but, like the elusive pimpernel, it evaded me. In the middle of it and yet not in it! I went along the avenue and walked about a mile or so criss-cross over the prairie in all directions, but it was always in the same place. It followed me when I retired and receded as I advanced. At last I became cold and went indoors. I became wet through when I hit the warm house. This caused me to rush to the telescope which I found to be as dry as a bone. Here was another puzzle to investigate. I placed my hand here, there and everywhere on the ground. Parts were wet and cold, others were dry and warm, and this got me guessing still more. Yet this atmosphere always receded as I advanced and followed me as I returned. . . . . I went out again, it was more intense than ever, and not a Scotch mist!

Venus as a Crescent with the Unaided Eye

Referring to the observation of Venus as a crescent by H. W. Cornell, of Milwaukee, printed in this Journal for January last, Dr. Fred W. Wood of Alhambra, Cal., writes:

In early January, 1934, I viewed the crescent of Venus as it was near maximum. It was approximately 4.30 p.m. as I opened my garage for my automobile, and as I started to close the same I noticed Venus shining through a faint haze or "high" fog as known out here. I was amazed at the clearness of Venus and saw a perfect crescent. I immediately called Mrs. Wood and she confirmed the same. I could easily observe the crescent from any place about the western part of our home lot. I took my 8-power binoculars and verified my naked-eye observation. As it grew dark and in the early twilight the crescent could not be seen except with the telescope.

This is the second time I have seen Venus as a crescent. Once before it was when Venus was near conjunction, about two and a half years ago, under similar atmospheric conditions. I make it a routine to observe Venus in late afternoon and early twilight, as more definite detail is possible and slight haze certainly does not hurt, as the air is seemingly more stable and with even temperature the mirror will not change.

Velocity of Light in a Partial Vacuum

Following almost a lifetime of endeavour to determine the velocity of light, the late A. A. Michelson in 1929 proposed to measure this fundamental constant of nature by the use of a long tube from which the air could be removed. The apparatus was installed at Irvine Ranch, near Santa Ana, California. The pipe was a mile long and was composed of 60-foot sections of corrugated steel pipe 36 inches in diameter; and by multiple reflection of the light from

end to end the light-path was made eight or ten miles long. The observations were made by F. G. Pease and Frank Pearson between February, 1931, and March, 1933, and the results were presented at the Cleveland meeting of the U.S. National Academy of Sciences. From 2,885 separate determinations the average velocity for light in a vacuum is given as 299,744 km. per sec. There seemed to be rapid changes in the velocity between successive individual determinations, and when these were arranged in series there were some variations in the series although they were small. Attempts to correlate the variations with tidal effects have not been successful.

C. A. C.

MEETINGS OF THE SOCIETY

AT HAMILTON

January 9, 1934.—The regular meeting was held in the lecture hall of the Public Library. Prof. W. Findlay, the President, occupied the chair.

Frank Aldous, a junior member, presented an excellent chart, made by himself, illustrating the time of sunrise and sunset during the year.

Prof. Findlay spoke on "Cosmic dust of the solar and stellar systems." Is the space between the stars and planets entirely empty or not? The speaker gave evidence to prove that interplanetary space is not empty by describing the zodiacal light, the solar corona, meteors and comets. Similarly the study of diffused nebulous light shows interstellar space also to be occupied by much scattered material.

February 13, 1934.—The meeting was held in the usual place. Prof. Findlay was in the chair.

Prof. W. H. McNairn, of McMaster University, spoke on "The meeting place of geology and astronomy." Geology as a science dates from 1788. By means of lantern slides it was shown that the appearance of the earth has been constantly modified by various forces. For many years geologists were occupied by the study of surface rock but eventually their attention was directed to the strata at deeper levels within the earth's crust. These were found to have been originally in a molten condition and were looked upon as forming the first surface of the earth. Further investigation however, threw doubt on this theory and so the problem of the origin of the earth became of interest to geologists.

Two groups consisting of T. H. Wingham and Prof. A. E. Johns, on one side, and W. S. Mallory and G. Campbell on the other, debated on the appearance of the earth as seen from Venus during the night of February 6, and other planetary or stellar observations from this planet.

March 13, 1934.—The meeting was held as usual in the Public Library, Prof. Findlay in the chair.

Prof. Johns introduced the speaker, Dr. C. A. Chant, of the University of Toronto, who gave an account of the construction and progress made on the David Dunlap observatory being erected near Toronto. By means of a series of slides and motion picture films the story of the undertaking was presented, from the choosing of the site for the building to the point of construction reached to date. The speaker then told of the great "eye" of the telescope, an immense block of pyrex glass 76 inches in diameter, 13 inches thick and weighing 5,000 lbs. Pictures showing each phase of the delicate operations of pouring, grinding and polishing were seen. The moving parts and mechanism of the telescope itself were then described, concluding a most interesting and instructive address.

April 10, 1934.—The meeting was held in the usual place. The speaker was Mr. J. A. Marsh, past-president of the Centre.

The topic "Nebulae and star clusters" proved of great interest. How these astronomical phenomena were formed and just what they are was discussed. Astronomy cannot be dictatorial on this question, but one theory is that at the beginning of time the space was filled with gas which gradually condensed into detached masses and eventually grew into huge condensations by absorbing the smaller masses. These nebulous masses slowly assumed regular shapes and the currents which started their existence caused them to rotate. As they shrank they flattened out and the gas on the outer fringes condensed into distinct masses and the stars as we know them were born, forming what may be called a "star-city". Tracing the process a little further we see a great drama enacted out in space. Two great stars approach each other, so close that tidal waves are created on each and portions of one star are pulled away, forming detached lumps but held in space to a set course by the gravitational pull of the parent body. Our planetary system possibly was thus formed. The surfaces of these detached bodies gradually cooled and hardened losing their original great heat and also their power to give off light, and one, at least, becoming finally capable of supporting life—our earth.

May 18, 1934.—The meeting was held in the lecture hall of the Public Library. Dr. Findlay presided.

Mr. H. Simmonds was elected a member.

Mr. Gibbs, of Grimsby, spoke on the Scott and Amundsen expeditions to the south pole, illustrated throughout with lantern slides. In this region of the earth the temperature sometimes reaches 80° F. below zero and for four months of the year darkness is continuous. Most explorers took a crew of about ten men, although the more recent expeditions of Byrd consisted of many more. Food and supplies are carried on sleighs drawn by tractors or dogs. Of special interest were the slides shown of the ill-fated Scott expedition and those of Amundsen and his men making the astronomical observations necessary to determine exactly the positions of the geographic south pole and the magnetic south pole.

June 19, 1934.—The annual field night was held at the home of Mr. W. T. Goddard. The evening was ideally suited to a study of the heavens and telescopes were set up and placed in charge of Mr. Goddard, Mr. J. Marsh, Rev. E. F. Maunsell, Dr. Smart, Dr. Bell, Mr. Freeman and others, who described the objects of interest on which they were trained. Approximately 130 members and friends attended this open night.

October 9, 1934.—The first meeting of the fall term was held in the lecture hall of the Public Library. The president, Dr. Findlay, presided.

The meeting took the form of an exhibition night. The hall was filled with astronomical apparatus of all kinds, together with charts and records of observations made by the members. Several members were asked to describe the many exhibits for the benefit of the audience. Mr. J. A. Marsh showed and explained the construction and mechanism of one of the larger telescopes.

Of special interest were the exhibits of Mr. Freeman and Mr. Marsh. The members were allowed to examine the various displays and received much knowledge of the use and workings of astronomical apparatus from this unusual meeting.

November 13, 1934.—The regular meeting was held in the usual place, Dr. Findlay in the chair.

Prof. A. B. McLay, of McMaster University, spoke on the subject, "The revelations of the spectroscope concerning stellar atmospheres." Dr. McLay set forth in detail, and illustrated by means of slides, the modern theory concerning the structure of the atom. It was shown how the absorption and emission of light are explained by changes in the orbits of the electrons about the nucleus of the atom. He showed how various questions concerning temperature, chemical, physical and electrical conditions in the envelopes surrounding the sources of light are answered by means of the character of the resulting spectra.

December 11, 1934.—The annual meeting of the Hamilton Centre, was held in the usual place. Dr. Findlay presided.

In the absence of Mr. G. Campbell the treasurer's report was read by Mr. J. A. Marsh.

Officers for 1935 were elected as follows:

Honorary President—Mrs. D. A. Marsh; President—Prof. William Findlay.

Vice-Presidents—Prof. A. E. Johns, T. H. Wingham, W. T. Goddard.

Secretary—N. Green, 186 Rosslyn Avenue North, Hamilton.

Treasurer—G. Campbell; Curator—T. H. Wingham.

Council—Dr. G. Jackson, S. W. Scammell, Mrs. S. W. Scammell, J. A. Marsh, Rev. J. Samuel, W. S. Mallory, J. S. Taylor, Rev. E. F. Maunsell, G. Freeman.

Prof. Findlay gave an account of the observations made by Mr. Marsh, Prof. Johns and himself during the recent Leonid meteor shower.

Rev. E. F. Maunsell, of Beamsville, spoke on the "Astronomy of the Bible." The creation story was traced through each phase as revealed in the book of Genesis from the time before the world to the finished work of the Creator. The speaker mentioned the beliefs of the early observers of the heavens. The earth was thought to be the centre of the universe and of first importance among the heavenly bodies in regard to size. The chief planets were known and their motions observed but were considered of no great importance. The moon and sun received much more attention and from their motions the calendar was based. Various references to astronomical phenomena throughout the Bible were pointed out by the speaker which reveal the findings and scientific thought of these early peoples.

AT TORONTO

December 11, 1934.—A regular meeting was held at 8.00 p.m., in the McLennan Laboratory, University of Toronto; Mr. R. A. Gray in the chair.

The following were elected members, the last two being members-at-large:

Mr. A. M. Crooker, 104 Campbell Ave., Toronto.

Mr. J. Westren, 138 Dunvegan Rd., Toronto.

Mr. W. A. F. McBryde, 54 Moore Ave., Toronto.

Mr. Kenneth O. Wright, University Observatory, University of Michigan, Ann Arbor, Mich.

Miss Florence Tobin, Nace, Alberta.

Mr. D. S. Archibald, of the Meteorological Service of Canada, was then introduced and presented an address on "A recent survey of some European meteorological services."

Starting with the well-equipped British service, he especially mentioned the elaborate weather bureau at Croydon Aerodrome, London. Cross-channel planes are never out-of-touch with the airport's wireless station, receiving continuous weather, wind, and direction signals while in flight. The French meteorological office is the only one, Mr. Archibald said, which uses a system of weather forecasting almost exclusively from cloud observations.

Passing on to Germany, Mr. Archibald, by means of lantern slides, took the audience to the Deutsche Seewarte at Hamburg, which observatory, in addition to its hydrographic work, carries on research in meteorology, the latter being centered at Hamburg airport. At Frankfort a specialty is made of cloud photography. While there is no official bureau at Leipzig, the University maintains a station where special attention is given to forest meteorology and microclimatology. Study of the upper atmosphere is centered in Germany at Berlin, where daily observations are made with kites and pilot balloons. At Munich is located a very interesting mountain observatory where information is obtained concerning the passage of air over the Alps.

Passing on to Norway, Mr. Archibald described the meteorological school in Bergen where he spent some time in a study of synoptic weather-map making under the direction of Dr. Bjerknes, who represents the third generation of a family of distinguished meteorologists. In Norway, he said, weather reports are gathered by radio at the regional offices, of which there are three, while in Canada and the United States the telegraph is almost exclusively used. From Bergen, headquarters of the central forecast region, Mr. Archibald went by railway to Oslo, the southern regional headquarters, visiting on the way several of the mountain observatories, to which on some occasions transportation was no easy problem, as shown by the slides and the very interesting motion pictures which followed.

E. J. A. Kennedy, Secretary, then presented his report for 1934. Membership was reported as 174 (including eight life members) an increase of one over 1933. While 22 new members had been added to the section during the year, 21 were lost through death or resignation. Thirteen meetings were held during the year, and in addition members received invitations to hear Sir Arthur S. Eddington in April, through the courtesy of the Royal Canadian Institute.

The appreciation of the members was conveyed to Mr. R. A. Gray for his services as Chairman during the year.

At a meeting held on December 11, 1934, the following officers were elected for 1935.

Honorary Chairman: Dr. C. A. Chant — Chairman: A. R. Hassard, K.C.
Vice-Chairman: E. J. A. Kennedy — Secretary: S. C. Brown
Treasurer: J. E. Maybee — Recorder: F. L. Troyer — Curator: R. S. Duncan

Members of Council with the above—Dr. D. S. Ainslie, Dr. L. Gilchrist,

F. L. Harvey, Dr. F. S. Hogg, J. H. Horning, Dr. P. M. Millman, Rev. C. H. Shortt, Dr. R. K. Young, T. H. Mason; and the Past-Presidents of the section—A. F. Hunter, M.A., J. R. Collins, and R. A. Gray, B.A.

This Council held its first meeting December 18, at which the following committees were appointed:

PROGRAMME—A. R. Hassard, chairman; R. A. Gray, Dr. L. Gilchrist, E. J. A. Kennedy, Dr. S. Beatty, J. R. Collins, secretary.

BUILDING—Dr. C. A. Chant, A. R. Hassard, A. F. Miller, H. L. Rogers, E. J. A. Kennedy.

MEMBERSHIP—E. J. A. Kennedy, chairman; Dr. R. K. Young, J. H. Horning, Rev. C. H. Shortt, F. L. Troyer.

OBSERVATION—Dr. P. M. Millman, chairman; Dr. C. A. Chant, J. R. Collins, A. R. Hassard, S. C. Brown.

January 29, 1935.—A regular meeting at 8.00 p.m., in the University of Toronto; A. R. Hassard in the chair.

Mr. H. G. Duncalfe then presented his paper on "Some popular fallacies concerning the moon, the rainbow and other natural phenomena." In dealing with natural phenomena we are often deceived by appearances. Sunbeams, as seen after a storm, do not radiate like spokes of a wheel—they are perfectly parallel. The sky is not a material vault, a dome or an inverted bowl which comes down to the horizon on all sides. Clouds are not mere featherweight affairs; they are extremely heavy. During a summer shower in which the rainfall is about one-twentieth of an inch, we have, over an area of one hundred square miles (approximately the size of Toronto), about four million tons of water vapour. The young crescent moon rising in the east, so often mentioned by poets and novelists, is a natural impossibility. There are many fallacies concerning the rainbow. No two people can see the same rainbow. On a level plain we cannot see a rainbow in the middle of the day; the sun must not be more than 42 degrees from the horizon. As the sun sinks lower, the visible portion of the bow increases, and when the sun is on the horizon, the crown of the rainbow is 42 degrees above the horizon. No more than one primary or one secondary rainbow may be seen at once, although the bow seen by the observer may be composed of several rainbows located at different distances but all superimposed upon each other.

FREDERIC L. TROYER, *Recorder.*

AT EDMONTON

December 13, 1934.—This was the Annual Dinner Meeting. Mr. F. S. Simpson gave an address on Some Astronomical Suggestions.

Mr. Simpson spoke of climatic changes which have occurred in many parts of the world. Traces of intense glacial action are found throughout Canada and the adjacent States as well as Europe and the more temperate parts of the southern hemisphere. Such traces may be in the form of grooves in the rocks, the moraines left by glaciers or, as in the prairies, the immense river valleys and in former ages by the rivers draining the melting ice, and now either entirely dry,

or containing streams much too small for them. Mention was also made of evidences that as far northward as the polar regions the presence of luxurious growth of coal plants and the discovery here and there of large reptiles, shows that this area also passed through long ages of comparatively hot climate. The reasons for these climatic changes are astronomic, which might well be further explored. The precession of the equinoxes offers a partial but far from sufficient cause of these changes.

He also spoke of the tides, of their importance to navigation and trade and of their being caused by the mutual attraction of the earth and the moon. The possibility of the earth's tidal influence on the liquid interior of the moon was given as one reason for the retardation of its revolution. And it was shown that in a similar way the earth's revolution on its axis was slowing up. A mathematical principle was mentioned by which this slowing up of the rotation of the earth and moon was balanced by their drawing further apart. The state of stable equilibrium which these two bodies are approaching is a state in which each will constantly present the same face to the other, and the day will be equal to the month, which will be about sixty of our present days.

The officers for 1935 are as follows:

Honorary President—Dr. J. W. Campbell.

President—Dr. E. H. Gowan; Vice-President—Mr. F. S. Simpson.

Secretary—Mrs. J. A. Clarke; Treasurer—Mr. W. H. Poole.

Council—Mr. M. J. Hilton, Miss E. M. Valens, Mr. F. L. Crosby, Mr. W. A. McAulay, Mr. A. B. McKim.

H. H. BEACH, *Secretary.*

AT VANCOUVER

December 11, 1934.—At the annual meeting the following officers for 1935 were elected:

Honorary President—Dean D. Buchanan President—Walter H. Gage
First Vice-Pres.—H. P. Newton Second Vice-Pres.—Mrs. C. M. Robson
Secretary—C. A. MacDonald Treasurer—A. Outram

Council—Mrs. Laura Anderson, H. C. B. Forsyth, J. L. Bennett, M. A. McGrath, H. A. Pitman, S. Richmond, Seto More, J. W. Moore, J. W. Pickin, and Past Presidents: Dr. G. M. Shrum, J. Teasdale, Dr. W. Ure.

AT LONDON

October 12, 1934.—The meeting was held in the London Life Auditorium, Mr. Gunn presiding.

A new member, Mr. K. W. Jeffries, 11 Euclid Ave., was elected to membership in the society.

The president read an item of interest from the *New York Times* on the atmosphere of Juniper and Saturn, after which he introduced the speaker of the evening, Dr. F. W. Tamblyn, of the Department of History and English, University of Western Ontario. His subject was "Astronomy in Literature."

Dr. Tamblyn spoke of the age-long interest in astrology manifested by the poets. Many expressions heard to-day, such as "I thank my stars," show the persistent belief that the stars influence the character and destiny of the individual. Chaucer followed the Ptolomaic theory of the universe while Milton hesitates between this and the Copernican theory but chooses the former in the plot of "Paradise Lost." Chaucer thinks of the many galaxies as the home of the blest and Shelley, the most star-minded of all the poets, pictures a sphere awaiting the soul of Keats as its king. Wordsworth finds the stars possessed of feeling and virtues, and Kipling recognizes them as friends. Reference was also made to Blake's "Address to the Evening Star."

A vote of thanks to the speaker was moved by Mr. T. C. Benson and seconded by Rev. W. G. Colgrove, the members heartily endorsing the same.

An observation of Algol's variations was conducted by Dr. Kingston. Before going to the roof, the members were shown the reason of these variations. The plane of revolution of the two stars, one less bright than the other passes nearly through the earth. Hence we see them brightest when they form an angle with our line of vision and dimmer when one of them eclipses the other. This double star was later pointed out to the members as well as the great nebula in Andromeda and other sights of interest in the evening sky.

There were 35 present at the lecture.

December 13, 1934.—At the annual meeting the following officers of the London Centre were elected:

Honorary President—Dr. H. R. Kingston
President—Major E. H. Anundson Vice-President—Mr. T. C. Benson
Secretary—Dr. G. R. Magee Treasurer—to be appointed (Miss) N. Morris pro. tem.

Council—Mrs. S. G. Hungerford, Mr. J. Middlebrook, Miss A. Tory, Rev. R. J. Bowen and Mr. A. J. Doke.

N. Morris, *Secretary-treasurer, '34.*

January 11, 1935.—The regular monthly meeting was held at 8.00 p.m. in the London Life Building, Major Anundson presiding. There were 55 people present.

The Observer's Handbook discussion was conducted by Dr. H. R. Kingston. As an item of current interest, the President described the discovery of Nova Herculis (1934) by the English amateur observer, Mr. J. M. Prentice, which was followed nine days later by the independent discovery of this same star by an American newsboy, Robert Lewis. On November 14, 1934, Nova Herculis was of the fourteenth magnitude, and now it is one of the twelve brightest stars in the sky. In position it is eight degrees north of Vega. The distance of the new star from our own planet is estimated to be approximately 1500 light years. The president concluded his report with a list of previously discovered bright novæ, the first of which appeared in Cassiopeia in 1572, the one previous to Nova Herculis appearing in 1920 in the constellation Cygnus. The constella-

tion study was directed by Mr. T. C. Benson, who employed well-made charts to describe the constellations visible during January. Considerable emphasis was placed on the constellation Orion, the speaker relating some of the legendary history built up around this constellation.

The main address of the evening was given by Dr. H. R. Kingston, his subject being "The Way of the Moon." Employing four tables of the same height, which surrounded a chair on which was placed a sphere to represent the sun, the speaker illustrated the motion of the earth around the sun, the plane of the table tops representing the plane of the ecliptic. The celestial sphere (or "sky") was next defined. The roles of the earth to sun were then interchanged, the globe which represented the earth being placed on the chair at the centre of the tables, and the apparent path of the sun around the earth was described. The circular path along which the sun appears to move in the sky is defined as the ecliptic. The celestial equator and the observer's horizon were also defined. Owing to the earth's daily rotation on its axis, the horizon circle is constantly changing. The plane of the ecliptic and the plane of the earth's equator intersect at an angle of $23\frac{1}{2}°$, consequently the ecliptic circle and the celestial equator intersect at the same angle. The actual path of the moon around the earth was described, the moon moving almost in the plane of the ecliptic. A plane representation of a portion of the celestial sphere which included the equator and the ecliptic was drawn on a blackboard, and the way the moon moves in the sky was shown to depend upon the relative positions of the moon and sun on their common path, the ecliptic. The speaker illustrated his remarks by selecting the times of the equinoxes and the times of the solstices, and in each case he described the path of the moon in its various phases. In this way, for example, it was clearly shown why the full moon is higher in the sky in winter time than during the summer.

G. R. MAGEE, *Secretary*.

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